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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

May 22, 1997

Docket Number 1974

Commissioner of Patents and Trademarks  
Washington, DC 20231

71122 U.S. PTO  
08/863113  
05/27/97

Sir:

Transmitted herewith for filing is the patent application of the Inventor(s), **André M. Goineau and Jerry N.**

**King**, for the invention entitled: **METHOD TO PRODUCE IMPROVED POLYMERIC YARN.**

1. Enclosed are two (2) sheet(s) of ormal drawings.

CLAIMS AS FILED, LESS ANY CLAIMS CANCELLED BY AMENDMENT

	Number Filed	Less	Equals	x Rate	TOTALS
Basic Fee	*****	*****	*****	*****	\$770.00
Total Claims	8	20	0	22.00	0.00
Independent Claims	2	3	0	80.00	0.00
<b>TOTAL FILING FEE</b>	*****	*****	*****	*****	<b>\$770.00</b>

2. A check in the amount of \$770.00 to cover the Filing Fee is enclosed.

3. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any over-payment to Deposit Account No. 04-0500.

May 22, 1997

Milliken Research Corporation  
P. O. Box 1927  
Spartanburg, South Carolina 29304  
Telephone Number: (864) 503-1599

Respectfully submitted,

*Earle R. Marden*  
Earle R. Marden  
Attorney for Applicant(s)  
Registration Number 19,301

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service in an envelope addressed to Assistant Commissioner of Patents, Washington, DC 20231, on May 22, 1997, along with the (1) Check # 133386 in the amount of \$770.00; (2) Specification containing: 4 pages, Claims - 2 pages, Abstract - 1 page, Declaration and Power of Attorney - 1 Page; (3) Two (2) Sheets of formal drawings; and (3) Post Card Receipt.

*Earle R. Marden*  
Earle R. Marden, Attorney for Applicant(s)

## METHOD TO PRODUCE IMPROVED POLYMERIC YARN

This invention relates generally to the production of a fully oriented industrial type yarn from a commercially available low molecular weight synthetic, multifilament POY polymeric apparel yarn such as polyester.

5       Commercially it is very expensive to purchase fully oriented industrial polymeric yarn from the fiber producer but partially oriented polymeric (POY) apparel yarns are readily available at reasonable prices but have to be drawn to produce a fully oriented yarn that is usable in many of today's industrial fabrics.

10       It is therefore an object of the invention to provide a method to treat POY apparel yarn to produce a fully oriented yarn which is acceptable for use in the production for commercially usable industrial woven and/or knit fabrics.

Other objects and advantages of the invention will become clearly apparent as the specification proceeds to describe the invention with reference to the accompanying drawings, in which:

15       Figure 1 is a schematic representative of the yarn treating process to be described herein and

Figure 2 is a modification of the process shown in Figure 1.

As discussed briefly, the invention is directed to low molecular weight POY multifilament, synthetic polymeric yarn such as polyester, nylon, etc. but in the preferred embodiment of the invention, a low molecular weight polyester 255 denier, 34 filament yarn 10 is shown being  
20       supplied from bobbins 12 through a reed 14 to the rolls 16, 18. The speed of the rolls 16, 18 and

rolls 20, 22 is selected to pretension the yarn 10 with a draw ratio of 1.01. The yarn 10 is then supplied to the draw zone 23 over the contact heater 24 operating at a temperature of 210°C. The speed of the rolls 20, 22 and the rolls 28, 30 is selected to draw the yarn 10 therebetween with a draw ratio of 2.093 to produce the fully drawn or oriented yarn 32. Prior to the nip of the rolls 28, 30, the yarns 10 are maintained in a spaced apart position by the reed 26. The fully drawn yarn 32 then passes through the dancer roll arrangement 34 at a speed of 200 yards per minute to the take-up roll 36.

The process of Figure 2 is similar to that of Figure 1 except that the yarn 10 is drawn in two hot draw stages with the heaters 19 and 24, both operating at a temperature of 210°C. In this modification, the drawing of the yarn 10 is done in Zone 1, designated 21, at a draw ratio of 2.114 with the draw Zone 2, designated 23, being used at the relaxing zone with a draw ratio of 0.940 to produce the desired fully oriented polyester yarn 32.

Today polyester products are typically spun in the partially oriented form (POY) which requires further drawing in the next processing step such as texturing, winding or twisting. The level of orientation achieved in the spinning operation determines the amount of drawing required to "fully orient" the yarn for final end uses.

An equation describing hot draw behavior is as follows:

$$\text{DRAWRATIO} = A \times \text{LN} \left( B \times \frac{\text{FINAL}}{\text{SPUN}} \right) + C$$

where:

$$\text{DRAWRATIO} = \text{Draw Ratio required to Achieve Desired Final Orientation}$$

FINAL = Final Orientation Measurement  
 SPUN = As Spun Orientation Measurement  
 A, B, & C = Material Property Constants Determined During  
 Experimentation  
 LN = Denotes Natural Logarithm

**NOTE:** The orientation measurement can be the quantitative results of any of the accepted methods for determining molecular orientation of polyester.

Experiments conducted using draw stress as a measure of molecular orientation resulted in the following equation:

$$\text{DRAW RATIO} = 0.2611 \times \text{LN} \left( 0.7649 \times \frac{\text{FINAL STRESS}}{\text{ORIENTATION INDEX}} \right) + 1.67$$

where:

FINAL STRESS = Stress (cn/denier) at final orientation  
 ORIENTATION INDEX = Stress (cn/denier) at a draw ratio of 1.6  
 CN = CentiNewton

If a drawing operation is designed to produce a product with fixed properties such as final orientation, tenacity and elongation using polyesters spun at different conditions, the process draw ratio can be adjusted to accommodate the different POY properties. The following table provides an example:

<u>POY ORIENTATION INDEX</u>	<u>PROCESS DRAW RATIO</u>
0.2 CN/DENIER	2.201
0.3 CN/DENIER	2.095
0.4 CN/DENIER	2.020
05. CN/DENIER	1.962
0.6 CN/DENIER	1.914

0.7 CN/DENIER	1.874
0.8 CN/DENIER	1.839

5       The span of orientation shown in the above table represents the current range of  
commercially available polyester POY products. The draw ratios shown should produce a final  
product at the same physical properties regardless of initial POY orientation. By selecting a draw  
ratio in the range of 1.8 - 2.3 provides a fully oriented polyester yarn at the same physical  
properties regardless of the initial POY orientation.

10       It can be seen that we have described a process in which commercially available POY  
apparel polyester yarn can be processed to produce a fully oriented industrial yarn which is  
acceptable for use in commercial fabrics without the expense of purchasing fully oriented yarn  
from the fiber producer. As is well known, industrial yarns with extreme high draw stress level  
are produced out of high molecular weight polyester which require an expensive poly  
condensation process resulting in a high price. The disclosed process produces an industrial yarn  
15       with the desired draw stress level from a commercially available relatively inexpensive lower  
molecular weight apparel POY polyester yarn.

Although we have described the preferred embodiment of our invention, we contemplate  
that many changes may be made without departing from the scope or spirit of our invention and  
we desire to be limited only by the claims.

## WHAT IS CLAIMED IS:

1. A process to provide fully oriented industrial yarn from low molecular weight polyester partially oriented yarn comprising the steps of: providing a bobbin of polyester POY multifilament synthetic yarn, supplying said yarn to a heater, drawing said yarn in a draw zone with a draw ratio in the range of 1.8 - 2.3 as it passes over the heater to produce a fully oriented yarn and taking up the fully oriented yarn.
2. The process of Claim 1 wherein said yarn is overfed about 1% to said draw zone.
3. The process of Claim 2 wherein said heater is operating at about a temperature of 210°C.
4. The process of Claim 3 wherein said yarn is pretensioned prior to the supply of same to the draw zone.
5. The process of Claim 2 wherein said drawn yarn is supplied to a second draw zone wherein it is relaxed.
6. The process of Claim 5 wherein heat from a heater operating at about 210°C relaxes said drawn yarn.
7. The process of fully orienting a 255 denier, 34 filament low molecular weight polyester

yarn comprising the steps of: supplying a 255 denier, 34 filament POY yarn, heating and drawing said yarn with a draw ratio of 2.093 to produce a fully oriented yarn and taking up the fully oriented yarn.

- 5      8.      The process of Claim 7 wherein the heater for said yarn is operated at a temperature of about 210°C.

ABSTRACT OF THE DISCLOSURE

A process to produce a fully oriented polyester yarn from a POY polyester yarn by drawing the POY yarn at a high draw ratio in the range of 1.8 - 2.3.

**DECLARATION FOR PATENT APPLICATION**

As below named inventors, we hereby declare that:

Our residence, post office addresses and citizenship are as stated below next to our names. We believe we are the original, first and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled **METHOD TO PRODUCE IMPROVED POLYMERIC YARN**, the specification of which is attached hereto.

We hereby state that we have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is known to be material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

We hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, we acknowledge the duty to disclose to the office information known to be material as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending or abandoned)

We hereby claim foreign priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Country)

\_\_\_\_\_  
(Filing Date)

**POWER OF ATTORNEY:** As named inventors, we hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Terry T. Moyer, Registration Number 26,008 and Earle R. Marden, Registration Number 19,301

**SEND CORRESPONDENCE TO:**

Terry T. Moyer  
P. O. Box 1927  
Spartanburg, SC 29304

**DIRECT TELEPHONE CALLS TO:**

Earle R. Marden  
(864) 503-1599

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**Full name of sole or first inventor:**

**André M. Goineau**

Inventor's Signature: \_\_\_\_\_

Date: May 22, 1997

Residence:

113 Hamilton Street  
P. O. Box 315, Williamston, SC 29697

Citizenship:

United States of America

Post Office Address:

113 Hamilton Street  
P. O. Box 315, Williamston, SC 29697

**Full name of second joint inventor:**

**Jerry N. King**

Inventor's Signature: \_\_\_\_\_

Date: May 22, 1997

Residence:

570 Bushy Creek Road  
P. O. Box 56, Reidville, SC 29375

Citizenship:

United States of America

Post Office Address:

570 Bushy Creek Road  
P. O. Box 56, Reidville, SC 29375

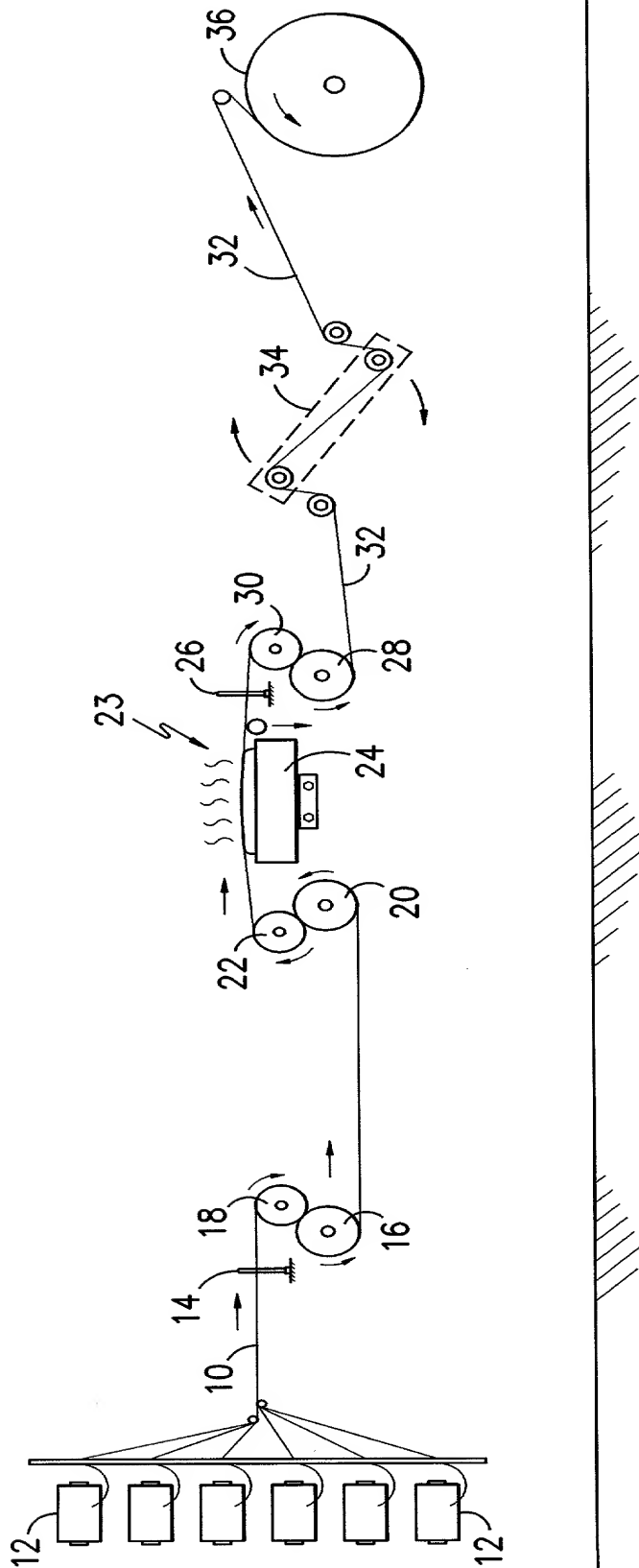


FIG. -1-

